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DIVISION 05 - METALS

SECTION 05210

STEEL JOISTS

06/04

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PART 1 GENERAL

1.1 REFERENCES

NOTE: The following references should not be
manually edited except to add new references.
References not used in the text will automatically
be deleted from this section of the project
specification.

The publications listed below form a part of this section to the extent
referenced:

ACI INTERNATIONAL (ACI)

ACI 503R (1993) Use of Epoxy Compounds with Concrete

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 317 (1992) Manual of Steel Construction,
Volume II, Connections

AISC S329 (1996) Structural Joints Using ASTM A 325
or ASTM A 490 Bolts

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.22.1 (1975; R 1998) Plain Washers

ANSI B18.22M (1981; R 2000) Metric Plain Washers

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4 (1998) Standard Symbols for Welding,
Brazing and Nondestructive Examination

AWS A5.1 (2003) Specification for Carbon Steel
Electrodes for Shielded Metal Arc Welding

AWS D1.1/D1.1M (2004) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A 194/A 194M (2003) Standard Specification for Carbon
and Alloy Steel Nuts for Bolts for
High-Pressure and High-Temperature Service

ASTM A 242/A 242M (2003a) High-Strength Low-Alloy Structural
Steel

ASTM A 307 (2003) Standard Specification for Carbon
Steel Bolts and Studs, 60,000 psi Tensile
Strength

ASTM A 325 (2004) Standard Specification for
Structural Bolts, Steel, Heat Treated,
120/105 ksi Minimum Tensile Strength

ASTM A 325M	(2004) Standard Specification for High Strength Bolts for Structural Steel Joints (Metric)
ASTM A 36/A 36M	(2003a) Standard Specification for Carbon Structural Steel
ASTM A 370	(2003a) Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A 490	(2004) Standard Specification for Heat-Treated Steel Structural Bolts, 150 psi Minimum Tensile Strength
ASTM A 490M	(2004) Standard Specification for High-Strength Steel Structural Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
ASTM A 563	(2004) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 563M	(2003) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A 568/A 568M	(2003) Standard Specifications for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM A 570/A 570M	(1998) Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM A 572/A 572M	(2002ae1) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality
ASTM A 6/A 6M	(2004a) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A 606	(2004) Standard Specification for Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM C 1107	(2002) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink)
ASTM C 150	(2002ae1) Standard Specification for Portland Cement
ASTM C 404	(2003) Standard Specification for Aggregates for Masonry Grout
ASTM E 165	(2002) Standard Test Method for Liquid

Penetrant Examination

ASTM E 709	(2001) Standard Guide for Magnetic Particle Examination
ASTM F 436	(2003) Hardened Steel Washers
ASTM F 436M	(2003) Hardened Steel Washers (Metric)
ASTM F 568M	(2002) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

STEEL JOIST INSTITUTE (SJI)

SJI Specs & Tables	(2002) Load Tables and Weight Tables for Steel Joists and Joist Girders
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THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PS 14.01	(2000) Steel Joist Shop Painting System
SSPC Paint 15	(1999) Steel Joist Shop Primer

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD 410	(Rev E; 1991) Nondestructive Testing Personnel Qualification and Certification (Eddy Current, Liquid Penetrant, Magnetic Particle, Radiographic and Ultrasonic)
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1.2 DESIGN REQUIREMENTS

1.2.1 Allowable Design Stress

Design stress for tension in steel joist chord and web members shall conform to the requirements of the SJI Specs & Tables specifications for steel joists.

1.2.2 Deflection

NOTE: Deflection due to design load must not exceed 1/360 of the span for roofs where a ceiling of any construction (not only plaster ceilings as specified in the SJI Specs & Tables specifications), piping, ductwork, conduit, or equipment is suspended or attached to the steel joists.

Deflection shall not exceed 1/360 of the clear span under the indicated uniform live load.

1.2.3 Allowable Loads

Total uniform dead and live load, uniform live load, and concentrated dead loads for design purposes shall be as indicated.

1.2.4 Bridging

NOTE: Where open web steel joists are used in floor construction, cross-bracing-type bridging may be required.

Bridging for open web steel joists shall be [horizontal] [cross bracing] type as specified in the SJI Specs & Tables specification and as indicated on the approved shop drawings.

Bridging for longspan and deep longspan steel joists shall be cross-bracing type as specified in the SJI Specs & Tables specification and as indicated on the approved shop drawings.

1.3 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01330 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication and Installation Drawings for Steel Joists shall be in accordance with paragraph entitled, "Fabrication," of this section.

SD-03 Product Data

Manufacturer's catalog data shall include type, voltage and amperage for Welding Equipment.

SD-05 Design Data

Design Analysis and Calculations shall be submitted in accordance with paragraph entitled, "Fabrication," of this section.

Mix designs shall be submitted for Portland Cement.

SD-07 Certificates

Welding Procedures shall be in accordance with AWS D1.1/D1.1M.

Factory Test Reports for the following shall be in accordance with paragraph entitled, "Manufacturer's Information," of this section.

Ladle Analysis of Steel

Tensile Properties and Bend Tests
Mechanical Tests
Chemical Composition and Mechanical Usability
Soundness Tests

Certificates for Steel Joists shall show conformance to SJI Specs & Tables.

Welders Certificates

SD-08 Manufacturer's Instructions

Installation instructions shall indicate the manufacturer's recommended method and sequence of installation for the following items:

Steel Joists
Epoxy-Resin Grout

1.4 QUALIFICATIONS FOR WELDING WORK

NOTE: If Section 05095 WELDING STEEL CONSTRUCTION
is not included in the project specification,
applicable requirements therefrom should be inserted
and the following paragraph deleted.

Manufacturer's catalog data for Welding Equipment shall include type, voltage and amperage.

[Section 05095 WELDING STEEL CONSTRUCTION applies to work specified in this section.]

[Welding Procedures shall be in accordance with AWS D1.1/D1.1M.]

Welder's Certificates shall be submitted to verify welders qualifications.

1.5 DELIVERY, STORAGE, AND HANDLING

Joists stored at the site before erection shall be stored off the ground on platforms or other supports and covered to provide an enclosure, while affording proper air circulation.

Packaged materials shall be stored in their original, unbroken packages in a dry area until ready for installation.

Epoxy-Resin Grout shall be delivered to the project site in a manner to avoid damage or loss. Storage areas shall be windowless and weatherproof but ventilated, insulated, noncombustible buildings with provisions nearby for conditioning the material at 70 to 85 degrees F 21 to 30 degrees C for a period of 48 hours before use. Ambient temperature in the storage area of the epoxy materials shall at no time be higher than 100 degrees F 38 degrees C.

1.6 MANUFACTURER'S INFORMATION

Factory test reports shall be submitted indicating all specification requirements with reference to the contract design.

1.6.1 Ladle Analysis of Steel

NEED Text HERE

1.6.2 Tensile Properties and Bend Tests

Tensile properties and bend test as specified in the particular referenced specification for the material and in ASTM A 6/A 6M for rolled steel plates, shapes and bars.

Tensile properties and bend test as specified in the particular referenced specification for the material in ASTM A 568/A 568M for rolled steel sheets and strip.

1.6.3 Mechanical Tests

Mechanical tests as specified in the referenced specifications for the material and in ASTM A 370 for high strength bolts.

1.6.4 Chemical Composition and Mechanical Usability

Chemical composition and mechanical usability as specified in AWS A5.1 for electrodes for manual shielded arc welding.

1.6.5 Soundness Tests

Soundness tests as specified in AWS A5.1 for electrodes for manual shielded arc welding.

PART 2 PRODUCTS

2.1 ROLLED STEEL PLATES, SHAPES, AND BARS

Plates, shapes, and bars are defined in ASTM A 6/A 6M and shall conform to the following:

[Structural quality carbon steel conforming to ASTM A 36/A 36M.]

[High-strength structural steel conforming to ASTM A 572/A 572M or ASTM A 242/A 242M with properties suitable for welding.]

2.2 STEEL SHEETS AND STRIP

[Sheets and strip shall be carbon steel of structural quality having minimum yield point of 40,000 pounds per square inch (psi) 275 Megapascal conforming to ASTM A 570/A 570M.]

[Sheets and strip shall be high-strength, low-alloy steel having minimum yield point of 50,000 psi 345 Megapascal conforming to ASTM A 606, Type 2.]

2.3 ELECTRODES FOR MANUAL SHIELDED METAL ARC WELDING

NOTE: Delete paragraph heading and following paragraphs when field bolted connections only are required.

Electrodes shall meet the requirements of AWS D1.1/D1.1M and shall be covered, mild-steel electrodes conforming to AWS A5.1 and as follows:

[Electrodes shall be [E60] [E70] series for connected members, both members having a minimum yield point of 36,000 psi 248 Megapascal.]

Electrodes having low-hydrogen-type coverings shall be dried for at least 2 hours between 450 and 500 degrees F 232 and 260 degrees C before they are used. Electrodes may be stored immediately after drying in storage ovens held at a temperature of at least 250 degrees F 120 degrees C. Electrodes that are not used within 4 hours after removal from a drying oven shall be redried before use. Wet electrodes shall not be used.

2.4 UNFINISHED THREADED FASTENERS

Unfinished bolts and nuts shall be regular hexagon type conforming to ASTM A 307, Grade A ASTM F 568M, Class 4.8 or lower.

Washers shall conform to ANSI B18.22.1 ANSI B18.22M, Type B.

2.5 HIGH-STRENGTH THREADED FASTENERS

NOTE: Delete following paragraphs when field connections of steel joists to the structural steel framing members are welded or when high-strength bolted connections are not required, or both. High-strength bolted connections, if used, must be indicated on the drawings.

Fasteners shall consist of heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers.

[High-strength bolts, including nuts and hardened washers, shall conform to ASTM A 325. ASTM A 325M.]

[High-strength bolts shall conform to ASTM A 490. ASTM A 490M. Nuts shall conform to ASTM A 194/A 194M, Grade 2H or ASTM A 563, Grade DH ASTM A 563M. Washers shall conform to ASTM F 436 ASTM F 436M.]

2.6 BEDDING MORTAR MATERIALS

[Shrinkage-resistant grout shall be a premixed and packaged ferrous-aggregate-mortar grouting compound conforming to ASTM C 1107, expansive cement type.]

[Portland Cement shall conform to ASTM C 150, Type I.]

Aggregate for cement grout shall be clean, sharp, uniformly graded natural sand conforming to ASTM C 404, Size No. 2.]

NOTE: Epoxy-resin grout may be used instead of shrinkage-resistant, grout-type bedding mortar.

[Epoxy-Resin Grout shall conform to applicable chapters of the ACI 503R, Part 3, Products and Processes.]

Mixing water for bedding mortar shall be potable.

2.7 FABRICATION

Design Analysis and Calculations shall be submitted to establish conformance with joist strength requirements of SJI Specs & Tables specifications for Steel Joists. Certificates to verify this compliance shall be submitted by the Contractor.

Installation Drawings for steel joists shall include details and layouts indicating wall, structural framing, and other supports; location, lengths, and marking of steel joists corresponding to sequence and procedure to be followed in placing and fastening, location and type of fasteners, and sequence of welded connections. Welds shall be indicated in accordance with AWS A2.4. Drawings shall also indicate accessories and methods of installation, details of longspan and deep longspan steel joists with sloped top chords, if required.

2.7.1 Open-Web Steel Joists

Open-web steel joists shall be shop fabricated of the specified rolled steel plates, shapes, and bars, or the specified steel sheets and strip, or a combination thereof, in accordance with the SJI Specs & Tables specifications.

2.7.2 Long-Span Steel Joists

Long-span steel joists shall be shop fabricated of the specified rolled steel plates, shapes, and bars or of the specified steel sheets and strip, or of a combination thereof in accordance with the SJI Specs & Tables specifications.

2.7.3 Holes in Chords

**NOTE: Size and spacing of holes in chords for
securing wood nailers and other work to the steel
joists must be indicated.**

Holes shall be provided in chords for securing other work to steel joists; the area of a hole shall be deducted from the area of a chord when computing strength of member.

Holes shall not be made or enlarged by burning, nor will the burning of unfair holes in the shop or field be acceptable.

2.7.4 Loose Bearing Plates

Plates shall be provided for steel joists bearing on masonry or concrete construction. Plates shall be flat, free from warps or twists, of the proper thickness and bearing area, and drilled to receive anchor bolts.

2.7.5 Joist Extended Ends

Extended ends shall conform to the manufacturer's standard for steel joists indicated on the approved shop drawings and descriptive data and shall conform to requirements of the applicable SJI Specs & Tables specification.

2.7.6 Ceiling Extensions

Ceiling extensions shall be provided for steel joists to support ceilings that are to be attached to the bottom of the joists. Extensions shall be either an extended bottom chord element or a loose unit, whichever is the standard with the steel joist manufacturer. Extensions shall be of sufficient strength to support ceiling construction and shall extend within 1/2 inch 13 millimeter of wall surface.

2.7.7 Header Members

**NOTE: When openings in the floor or roof surfaces
require header members exceeding the joist spacing,
such openings must be framed with steel supporting
members that are provided as a part of the
structural steel framing system.**

Rolled steel header members shall be provided for support of steel joists at openings where indicated. Headers shall be in accordance with the manufacturer's standard for steel joists indicated on the approved shop drawings and descriptive data.

2.7.8 Shop Painting

Steel joists and accessories shall be given one coat of the specified paint in accordance with SSPC PS 14.01.

Paint shall be shop paint primer conforming to SSPC Paint 15, Type I, (red oxide).

PART 3 EXECUTION

3.1 GENERAL

Steel joists and accessories shall be installed in accordance with the approved shop drawings and descriptive data, and as specified.

Care shall be exercised in handling and placing joists. Joists shall be fastened in place and bridging installed prior to receiving construction loads. Contractor shall coordinate joist location with access space and fixture-placing requirements of other trades.

Special fittings for openings, overhangs, and ceiling extenders shall be furnished where required and not otherwise detailed or specified.

3.2 WELDING

Welding and weldments shall conform to the applicable requirements of AWS D1.1/D1.1M.

3.3 ANCHORS

Anchor bolts and other anchors required for connection of steel joists supported on, attached to, or built into masonry or concrete construction shall be correctly located. Anchors shall be set by use of templates or other methods required to locate the anchors accurately.

3.4 SETTING LOOSE BEARING PLATES

3.4.1 Cement and Shrink-Resistant Grout

Plates for steel joists supported on masonry or concrete construction shall be fully bedded on wedges or shims and damp-pack bedding mortar.

Installation of plates shall be as follows:

Masonry and concrete bearing surfaces shall be clean. Concrete surfaces shall be roughened. Bottom surface of plates shall be clean.

Space between top of bearing surface and bottom of plate shall be approximately $1/24$ of the width of plate but not less than $1/2$ inch 13 millimeter for plates that are less than 12-inches 300 millimeter wide.

Bearing plate shall be supported and aligned on steel wedges or shims.

[Bedding mortar shall be a mix composed of the specified shrinkage-resistant grout and enough water to provide a flowable mixture without segregation or bleeding, with a water/cement ratio of 0.50 to 1.00 by weight.]

[Bedding mortar shall be a mix composed of 1 part portland cement, 2-1/2 parts of aggregate for cement grout, and not more than 4-1/2 gallons 17 liter of water per 94-pound 43-kilogram bag of portland cement.]

Forms shall be provided to retain mortar until it is sufficiently hard to be self-supporting.

After supporting members have been positioned and the anchor bolts tightened, space between top of bearing surface and bottom of bearing plate shall be packed with mortar mix by tamping or ramming with a bar or rod until voids are filled.

Wedges or shims shall not be removed, but, when protruding, shall be cut off flush with the edge of the bearing plate prior to packing with mortar.

Mortar, after receiving its initial set, shall be kept damp for a minimum of 24 hours.

3.4.2 Epoxy-Resin Grout

Epoxy-resin grout components shall be mixed in the proportions recommended by the manufacturer. Components shall be conditioned to 70 to 85 degrees F 21 to 30 degrees C for 48 hours prior to mixing. Two epoxy-resin grout components shall be mixed with a power-driven, explosion-proof stirring device in a metal or polyethylene container having a hemispherical bottom. Polysulfide curing agent component shall be added gradually to the epoxy-resin component with constant stirring until a uniform mixture is obtained. Rate of stirring shall be such that entrained air is minimum.

Protective clothing, gloves, and eye-protective devices shall be provided for workmen engaged in epoxy-resin grout mixing and placing.

Adequate ventilation and fire protection precautions shall be maintained during mixing and placing.

Installation requirements not specified shall be in accordance with the epoxy-resin grout manufacturer's printed installation instructions and as approved.

3.5 PLACING STEEL JOISTS

Supporting members shall be in place before placing of joists is started. Joists shall be placed on the supporting framework and adjusted and aligned accurately, with ends bearing on supporting members, before being permanently fastened. End supports shall be as specified. Placing and aligning joists shall be done to attain the number and spacing indicated on the approved shop drawings.

End support for [short-span] [long-span] steel joists shall be as specified in accordance with the SJI Specs & Tables specifications.

3.6 BRIDGING

NOTE: When fire-resistance-rated construction is required, consult fire-rating agency's design and material requirements for the applicable roof or floor construction.

As soon as steel joists are placed, bridging shall be completely installed. Size of bridging members shall be as indicated on the approved shop drawings.

Bridging shall conform to requirements of the SJI Specs & Tables specification. Each line of bridging shall be securely anchored to walls or supports at the ends of the line and to each joist by welding or bolting.

3.7 FASTENING STEEL JOISTS

NOTE: When fire-resistance-rated construction is required, consult fire-rating agency's design and material requirements for the applicable roof, floor, or ceiling construction.

[Steel joists resting on steel supporting members shall be connected by welding. Welds shall be as specified in the SJI Specs & Tables specification for type of joists used and as indicated on the approved shop drawings. Welding sequence shall be coordinated with placing of joists.]

[Steel joists resting on steel supporting members shall be connected by bolting. Bolting shall be as specified in the SJI Specs & Tables specifications for the type of joist used, as indicated on the approved shop drawings, and as specified. Bolting sequence shall be coordinated with placing of joists. Bolted connections shall be as follows:

[Unfinished threaded fasteners shall be used for bolted connections.]

[Unfinished threaded fasteners shall be used for bolted connections of joists to purlins, bearing plates on supporting walls, wall anchors, and elsewhere except where high-strength bolted connections are indicated.]

[High-strength threaded fasteners shall be used for bolted connections of joists to steel columns and elsewhere as indicated. High-strength bolted connections shall be installed in accordance with AISC S329.]]

NOTE: Delete following paragraph when steel joists supported on masonry or concrete construction are resting on steel bearing plates specified in the paragraph, "Setting Loose Bearing Plates."

[Joists resting on masonry or concrete bearing surfaces shall be bedded in mortar and anchored to masonry or concrete construction as specified in the SJI Specs & Tables specification.]

3.8 TOUCHUP PAINTING

After joist installation, field welds, bolt heads and nuts, and scarred surfaces on joists and steel supporting members shall be touchup painted. Before touchup painting, weld scars, bruises, abrasions, and rust spots shall be wire-brushed and solvent-cleaned. Paint for touchup painting shall be the same as that used for shop painting.

3.9 INSPECTION AND ACCEPTANCE PROVISIONS

3.9.1 Inspection and Tests

Inspection by the Contracting Officer will include proper preparation, size, gaging location, and acceptability of welds; identification marking; operation and current characteristics of welding sets in use; and calibration of wrenches for high-strength bolts.

Repair of damaged joists will be allowed only if approved. Method of repairs shall be in accordance with the manufacturer's recommendation.

3.9.2 Inspection of Welds

NOTE: Location of welds requiring inspection and type of inspection must be indicated on the drawings.

If weld inspection is desired, the liquid penetration method is the most economical and commonly used.

Inspection of welded joints shall be performed in accordance with AWS D1.1/D1.1M, and as follows:

[Liquid penetrant inspection of welds shall conform to ASTM E 165.]

[Magnetic particle inspection of welds shall conform to ASTM E 709.]

[Welding inspectors shall be certified in accordance with MIL-STD 410.]

3.9.3 Inspection of High-Strength Bolt Connections

Inspection of connections shall be performed in accordance with AISC 317.

-- End of Section --